Stock Market Microstructure in Spain: A Note

J. Ignacio Peña
Universidad Carlos III de Madrid, Spain

This note addresses some microstructure consequences of the Spanish Stock Exchange Reform on measures of systematic risk of daily asset returns. The Reform modified the trading system, clearing and settlement procedures among other changes. This note focuses on how these events affected systematic risk measures and autocorrelations in a sample of selected stocks. After the Reform significant decreases in autocorrelations and lower biases in the betas are found, suggesting that the Reform had increased market's operational efficiency. However, Banks sector have special features which are explained in terms of trade mechanisms.

1. Introduction

Research in microstructure analysis has blossomed in the last ten years. Since the book by Cohen et al. (1986) there is a growing work in this area, see Modest (1993) for a recent review. Microstructure analysis considers the interplay among market agents, trading systems and the behavior of security returns when trading is affected by frictions, like delays in settlement procedures or transaction costs.

When the trading mechanisms changes, as has been the case in London's Big Bang in 1986 or Paris in 1987, one interesting aspect is how the new regimes affect the order flow and prices formation. One example is the paper by Pagano and Roell (1990) on the Paris Bourse.

For the Spanish stock market whose Big Bang was in 1989, there are few studies on these issues. The work by Urrutia (1990) focused on the volatility and volume effects after the change in the market's settlement and trading procedures. He found evidence of lower volatility in almost all sectors except the Banking sector whose volatility increased, and no clear effects on volume after the reforms. In an extensive analysis of the Banking sector, Berges and Soria (1992) found similar results. This note aims to extend previous research using the same database but focusing on some microstructure consequences of the Spanish Stock Exchange Reform on measures of systematic risk of daily asset returns. The Reform modified the trading system, clearing and settlement procedures among other changes. This note focuses on how these measures affected systematic risk measures and autocorrelations in a sample of selected stocks. The paper is organized as follows. Market structure is discussed first. Then we present data, methodology and results. We address concluding remarks in the final section.

2. Market Structure

There are four stock exchanges in Spain; Madrid, Barcelona, Valencia and Bilbao. Madrid is the dominant exchange, accounting for almost 90% of trading activity. At the end of 1993 the total market value of equities quoted on the Madrid Stock Exchange was about 1% of World's capitalization. The largest individual sector was Banking (24% of the total), followed by Electrical Utilities (21%), Telecommunications (11%), Oil and Chemicals (10%), Construction (8%), Investments (6%) and Iron & Steel (5%). Foreign investors are free to invest in the Spanish securities markets. The market is an order driven market, in contrast with other exchanges (NYSE, LSE) which are quote driven markets.

The Spanish Securities Market Act (SSMA) took effect in July 1989 and its main points are (among others) as follows. Official Stock Market Agents, previously appointed by the Government, were replaced by private Brokers and Dealers. Trading mechanism was changed with the introduction of the Computer Assisted Trading System (CATS) open from 11:00 am to 5:00 pm and the termination of the traditional open outcry trading process[1]. Brokerage Fees were liberalized. Also the National Stock Exchange Commission (CNMV), Spain's version of the US's SEC, was created.

A new settlement and clearing service was created (NSL) and was operational at the same time that CATS; cash balances are cleared in 48 hours. Before SSMA, cash balances of operations from one given week (Monday to Friday) were cleared on next week Friday. The settlement period is T+10, and before SSMA was T+30. In April 1993 the CNMV opened its new Servicio de Compensacion y Liquidacion (SCVL), the securities settlement and clearing service aimed at expediting the settlement period. The new system initially reduces the settlement period in Spain from T+10 and in some cases T+15 to T+7; later in 1994 the exchange believes this period will be reduced further to T+5.

To give one reference of CATS evolution, it started on April 1989 and on May 1990, securities listed on CATS represented almost 90% of the total market value of Madrid Stock Exchange.

3. The Data

In this paper we use a sample of 37 stocks, which are both the most frequently traded at Madrid2 and the most important of each sector. These stocks are representative of the nine sectorial divisions (Foodstuffs, Banks, Communications, Construction, Utilities, Investment Funds, Chemicals, Iron & Steel and Others) and account for almost 60% of Trading Volume at Madrid.

The sample are daily returns from January, 1 1988 to July 30, 1990[3], so there are 638 data points for each firm. There are from 350 to 450 data (depending on the date of first listing in CATS) before the securities were listed in CATS and from 300 to 200 after the listing. Table 1 summarizes number of firms in each sector, sectorial market value and weight in the IGBM.

Table 1

SECTOR	FIRMS	SECTOR M.V.	IGBM WEIGHT
Foodstuffs	3	44.1%	2.3%
Banks	4	55.1	17.0
Communication	2	90.1	7.7
Construction	6	50.2	6.9
Electric U.	6	88.7	13.1
Investment	2	40.3	2.3
Chemical	5	34.5	3.8
Iron & Steel	8	40.5	2.4
Various	1	45.2	1.7

This sample has been chosen to minimize possible influences from the October 1987 meltdown, and from the Gulf crisis at the beginning of August 1990. However we could not avoid possible effects from the "mini-crash" of October 1989.

As a "market" factor we use the Madrid Stock Exchange's general Index (IGBM). It is made up each year of 70-90 companies and represents about 80-85 % of the total capitalization of the market, excluding foreign stocks. It accounts for dividends and stock splits, and is a market value weighted index. Therefore it should reflect mainly the behavior of the big firms.

4. Methodology

Our target is to study if the Reform affected systematic risk measures and autocorrelations in returns. We define returns as the natural logarithms of price relatives adjusted for dividends and splits. We assume that the "true" return $\mathbf{r}_{jt}$ for security **j** in time **t** is generated by the market model

$$r_{j,t} = a_j + \beta_j R_t + e_{j,t} \qquad (1)$$

where $\mathbf{R}_t$ is the market index "true" return. We also assume that due to frictions in the trading process some kind of price-adjustment delay happens. Thus we obtain a series of <u>observed</u> returns for security **j** in time **t**, $\mathbf{r}_{jt}$ which are related to true returns as follows:

$$r^{0}_{j,t} = \sum_{n=0}^{N} \Phi_{j,t-n,n}\, r_{j,t-n,n} \quad (2)$$

where **F** are independent random variables both between true returns and between securities. In equation (2), $\mathbf{F}_{j,t-n,n}$ is the proportion of the true return $\mathbf{r}_{j,t-n}$ generated in time **t-n** included **n** periods later in the observed return in time **t**. If there are no delays, $\mathbf{F}_{j,t-n,n}$ is zero for any positive **n** and one for **n**=0. Different assumptions about possible values for the realization of random variable **F**, and time delay **n** provides different models for the adjustment process. Scholes and Williams (1977), fixed **n** = 1, and Cohen et al. (1983) extended their analysis to **n** > 1. In essence, the idea is that observed returns are computed as linear combinations of true returns with fixed (and known) lags (**n**) and parameters ($\mathbf{F}_{j,t-n,n}$) The model is further extended by Lo and MacKinlay (1990) which allow for any lag **n** and random parameters.

Our first target is the estimation of measures of systematic risk in our data before and after the reforms. We use the market model (1). However, for the observed returns, the "observed" market model is

$$r^{0}_{j,t} = \alpha^{0}_{j} + \beta^{0}_{j} R^{0}_{t} + \varepsilon^{0}_{j,t} \quad (3)$$

It is well known that OLS estimators of beta are biased and inconsistent is there are delays in price adjustments. To cope with these problems we estimate the betas using the Scholes and Williams (1977) (SW) and Cohen et al.(1983a) (CHMSW) estimators The SW method uses a variate of the observed market model

$$r^{0}_{j,t} = \alpha^{0}_{j} + \beta^{0}_{j,k} R_{t+k} + \varepsilon^{0}_{j,t} \quad k = -1,0,1 \quad (4)$$

and the consistent estimator of systematic risk is

$$\beta_{j} = \sum_{k=-1}^{1} b^{\,0}_{j,k} \;/\; (1 + 2\hat{\rho}_{1}) \qquad (5)$$

where $b^{\,0}_{j,k}$ are OLS estimators and ρ_{1} is the (observed) first order autocorrelation coefficient of market index returns.

Another consistent estimator of true beta can be found using the CHMSW method which allows for more than one day in price adjustments (i.e. **n** > 1). The estimator is

$$\beta_j = (b_j^0 + \sum_{n=1}^{N} b_{j+n}^{0} + \sum_{n=1}^{N} b_{j-n}^{0})\,/\,(1 + 2\sum_{n=1}^{N} \hat{\rho}_n) \quad (6)$$

Estimated residual first order autocorrelation from (3) are then analyzed, before and after reforms using OLS, SW and CHMSW estimators.

5. Results

Table 2 present OLS betas and first order residual autocorrelations for total sample and before and after CATS[4]. Standard errors are computed using heteroscedastic-consistent procedures, see White (1980). Overall, systematic risk are lower after CATS and autocorrelations are lower and nonsignificant. However the Banks sector behaves differently. Their betas increase and their autocorrelations are lower than before CATS but still significant. Also in agreement with results in Urrutia (1990) residual volatility is lower after CATS.

To take into account price-adjustment delays and other possible frictions we reestimate all models using SW and CHMSWs estimators, which are displayed in Tables 3 and 4. As results are similar, we summarize them jointly. Before CATS, betas tend to be lower than OLS estimators but there are no clear cut differences with them, but with two exceptions. The Banks sector estimators are much higher (i.e. systematic risk could be greater than the OLS betas) and Communications sector betas are lower. After CATS, OLS, SW and CHMSW estimators are in close agreement, suggesting that price adjustments are faster than before.

Residual autocorrelations are pretty similar as were with OLS estimators, a result not very surprising given the results in Brown and Warner (1985). Before CATS some sectors present significant first order autocorrelations, specially Banks and Communications. After CATS, only Banks remain with significant figures, which suggests less frictions in the price formation process.

5.1 A Comment on Why Banks are Different

It can be argued that before CATS, trading systems are one relevant factor for the peculiar Banks sector behavior. The usual trading system for all non-Banks stocks before CATS where a verbal call auction ("à la crieé"). But Banks were traded on a written order entry system ("par cassiers"). The system was as follows: trading orders are accumulated in an order "book". If supply and demand do not exactly balance, one clearing price is set which maximizes trading volume. Therefore if one order is of high volume enough, it can influence the final "equilibrium" price.

The work by Berges and Soria (1992) suggests that Banks used to "care" about the pricing of their own stock, directly or through participated firms, using tactics like using "stoppers" (i.e. high volume orders) to keep prices around desired targets. These strategies, if permanently applied, could help to explain the two basic features that distinguish the Banks sector from others. First, repeated interventions of this kind could create dependence in price changes. Second, relationship with market evolution should be weaker. That is exactly the kind of features we find in the Banks sector. Strong first order autocorrelation, which suggests an almost daily interventions and then, low betas that when corrected for price delays increased significantly. After the reform, OLS betas and adjusted betas are similar, and autocorrelations decreased, suggesting that CATS prevents to some extent these intervention tactics.

6. Conclusions

Some microstructure consequences of the Spanish Stock Exchange Reform on measures of systematic risk and autocorrelations of daily asset returns are studied. Using a sample of selected stocks we find after the Reform significant decreases in autocorrelations. The Banks sector shows some special features, which are explained in terms of the trading mechanism. Results suggests that some kind of price intervention was not uncommon before CATS. After CATS the evidence is much weaker, suggesting that the Reform had increased market's operational efficiency.

Footnotes

[1] The old trading system were based on daily auctions developed at fixed time intervals, and with only three hours of total trading time (from 10 AM to 1 PM).

[2] There are about 400 securities listed in the Madrid Stock Exchange, but only 80 are actively traded. We consider only securities not affected by takeovers or other disturbing events. Given these restrictions we tried to choose a representative enough sample.

[3] The reader interested in details of the construction of the return series and corrections for dividends, stock splits, and other effects should consult Urrutia (1990).

[4] Only results for sectors are presented, which are equally weighted portfolios of individual securities. We also performed the analysis with market value weighted portfolios and results were very similar. These results and the ones for individual stocks are available on request.

[5] CHMSW estimators for values of $\mathbf{n} = 2, 3, 4, 5$ were computed (available on request). Figures in Table 4 are for $\mathbf{n} = 5$. The differences between them are small due to low autocorrelations in the index market returns.

Footnote

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Table 2.

	(1)	(2)	(3)	(4)	(5)	(6)
FOOD	1.31 (0.09)	1.48 (0.10)	0.92 (0.24)	0.03 (0.03)	0.18 (0.04)	0.08 (0.09)
BANK	0.78 (0.05)	0.64 (0.04)	1.27 (0.15)	0.34 (0.03)	0.37 (0.04)	0.25 (0.07)
COMM	1.08 (0.05)	1.24 (0.07)	0.57 (0.09)	-0.15 (0.04)	-0.18 (0.04)	0.11 (0.06)
CONS	1.67 (0.09)	1.77 (0.11)	1.44 (0.12)	0.10 (0.03)	0.13 (0.05)	0.08 (0.07)
ELEC	1.16 (0.05)	1.28 (0.10)	0.96 (0.06)	0.05 (0.03)	0.12 (0.03)	0.09 (0.06)
INVS	0.84 (0.07)	1.03 (0.11)	0.50 (0.03)	0.04 (0.02)	0.11 (0.04)	0.03 (0.06)
CHEM	1.63 (0.12)	1.73 (0.12)	1.44 (0.14)	0.03 (0.03)	0.06 (0.03)	0.02 (0.06)
IRON	1.68 (0.11)	2.03 (0.21)	1.09 (0.15)	0.06 (0.03)	0.08 (0.04)	-0.02 (0.07)
OTHR	1.54 (0.10)	1.61 (0.17)	1.46 (0.16)	0.08 (0.03)	0.16 (0.05)	-0.03 (0.05)
ALL STOCKS	1.34 (0.08)	1.48 (0.11)	1.10 (0.14)	0.08 (0.03)	0.10 (0.04)	0.06 (0 07)
(7)	0.0165	0.0181	0.0158	0.0152	0.0168	0.0144

(1) OLS Beta total sample (2) OLS Beta before CATS (3) OLS Beta after CATS (4) First order residual autocorrelation total sample (5) First order residual autocorrelation before CATS (6) First order residual autocorrelation after CATS (7) Residual standard error (total portfolio)

Numbers in brackets are heteroscedastic-consistent asymptotic standard errors (White's covariance matrix).

Table 3.

	(1)	(2)	(3)	(4)	(5)	(6)
FOOD	1.26 (0.06)	1.43 (0.09)	0.96 (0.21)	0.04 (0.03)	0.17 (0.04)	0.07 (0.08)
BANK	1.03 (0.04)	0.90 (0.05)	1.32 (0.12)	0.30 (0.03)	0.34 (0.04)	0.23 (0.08)
COMM	0.77 (0.04)	0.86 (0.06)	0.52 (0.08)	-0.13 (0.04)	-0.17 (0.04)	0.11 (0.06)
CONS	1.65 (0.07)	1.73 (0.09)	1.40 (0.10)	0.10 (0.03)	0.13 (0.05)	0.08 (0.07)
ELEC	1.02 (0.04)	1.10 (0.10)	0.85 (0.04)	0.04 (0.03)	0.11 (0.03)	0.08 (0.06)
INVS	0.79 (0.06)	1.05 (0.10)	0.42 (0.03)	0.04 (0.02)	0.11 (0.04)	0.03 (0.06)
CHEM	1.46 (0.10)	1.54 (0.11)	1.33 (0.12)	0.03 (0.03)	0.06 (0.03)	0.02 (0.06)
IRON	1.66 (0.09)	1.96 (0.18)	1.14 (0.11)	0.06 (0.03)	0.08 (0.04)	-0.02 (0.07)
OTHR	1.62 (0.08)	1.85 (0.12)	1.36 (0.13)	0.08 (0.03)	0.17 (0.05)	-0.03 (0.05)
ALL STOCKS	1.25 (0.05)	1.38 (0.10)	1.03 (0.12)	0.07 (0.03)	0.09 (0.04)	0.05 (0.07)
(7)	0.0163	0.0196	0.0158	0.0152	0.0171	0.0146

(1) SW Beta total sample (2) SW Beta before CATS (3) SW Beta after CATS (4) First order residual autocorrelation total sample (5) First order residual autocorrelation before CATS (6) First order residual autocorrelation after CATS (7) Residual standard error (total portfolio)

Numbers in brackets below Betas are asymptotic standard errors (Scholes and Williams (1977) equation 26)) and below autocorrelation estimators are heteroscedastic-consistent asymptotic standard errors (White's covariance matrix).

Table 4.

	(1)	(2)	(3)	(4)	(5)	(6)
FOOD	1.20	1.39	1.06	0.04 (0.03)	0.17 (0.04)	0.07 (0.08)
BANK	I.10	0.94	1.34	0.30 (0.03)	0.34 (0.04)	0.23 (0.08)
COMM	0.71	0.80	0.51	-0.13 (0.04)	-0.17 (0.04)	0.11 (0.06)
CONS	1.64	1.71	1.38	0.10 (0.03)	0.13 (0.05)	0.08 (0.07)
ELEC	0.97	1.02	0.81	0.04 (0.03)	0.11 (0.03)	0.08 (0.06)
INVS	0.72	1.04	0.51	0.04 (0.02)	0.11 (0.04)	0.03 (0.06)
CHEM	1.36	1.52	1.23	0.03 (0.03)	0.06 (0.03)	0.02 (0.06)
IRON	1.56	1.90	1.15	0.06 (0.03)	0.08 (0 04)	-0.02 (0.07)
OTHR	1.64	1.83	1.31	0.08 (0.03)	0.17 (0.05)	-0.03 (0.05)
ALL STOCKS	1.21	1.18	.98	0.07 (0.03)	0.09 (0 04)	0.05 (0 07)

(1) CHMSW Beta total sample (2) CHMSW Beta before CATS (3) CHMSW Beta after CATS (4) First order residual autocorrelation total sample (5) First order residual autocorrelation before CATS (6) First order residual autocorrelation after CATS

Numbers below autocorrelation estimators are heteroscedastic-consistent asymptotic standard errors (White's covariance matrix).

References

Berges, A. y P. Soria (1992) **Comportamiento Bursatil de los Bancos Espanoles.** Civitas Escuela de Economia.

Brown, S.J. and J. Warner (1985) Using Daily Stock Returns: the Case of Event Studies. **Journal of Financial Economics,** 14, 3-31

Cohen, K.J., G. A. Hawawini, S.F. Maier, R.A. Schwartz and D. K. Whitcomb (1983a) Friction in the Trading Process and the Estimation of Systematic Risk. **Journal of Financial Economics,** 12, 263-278.

Cohen, K.J., S.F. Maier, R.A. Schwartz and D. K. Whitcomb (1986) **The Microstructure of Securities Markets.** Prentice-Hall.

Lo, A.W. and A. C. MacKinlay (1990) An Econometric Analysis of Nonsynchronous Trading. **Journal of Econometrics,** 45, 181-211.

Modest, D. M. (1993) Market Microstructure: An Empirical Retrospective. mimeo. University of California at Berkeley.

Pagano, M. and A. Roell (1990) Shifting Gears: An Economic Evaluation of the Reform of the Paris Bourse. **LSE Financial Markets Group Discussion Paper.**

Scholes, M. and J. Williams (1977) Estimating Betas from Nonsynchronous Data. **Journal of Financial Economics,** 5, 309-327.

Urrutia, J. (1990) Efectos del paso al Mercado Continuo sobre la Volatilidad de los Precios y el Volumen de Contratacion. **Moneda y Credito,** 121, 41-71.

White, H. (1980) A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. **Econometrica,** 48, 817-38.